

CLAIMS

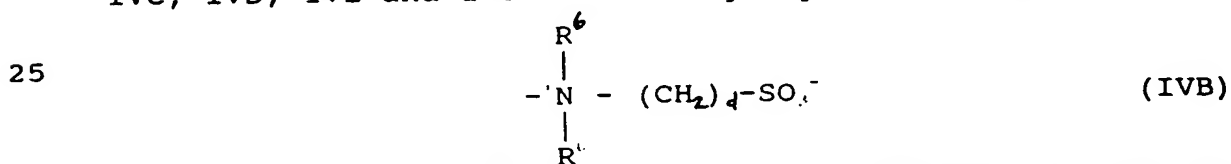
1. A process in which a substrate having a surface which bears substrate pendant functional groups is coated with a coating composition containing a polymer formed from a radical polymerisable monomers including a radical polymerisable zwitterionic monomer and a radical polymerisable monomer containing a reactive group to form a polymer having zwitterionic groups and pendant reactive groups and the said pendant reactive groups are reacted to form covalent bonds with said substrate pendant functional group and thereby form a stable coating of polymer on the said surface, and wherein

said zwitterionic monomer has the general formula I



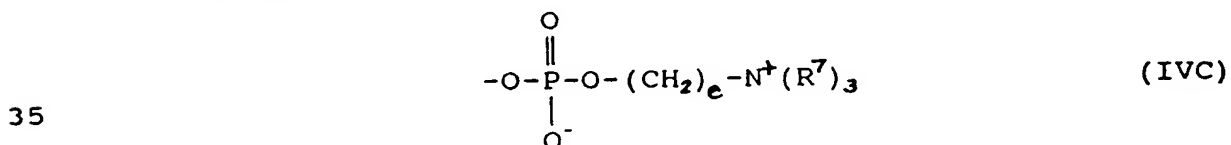
wherein B is a straight or branched alkylene, oxaalkylene or oligo-oxaalkylene chain optionally containing one or more fluorine atoms up to and including perfluorinated chains, or if X contains a carbon-carbon chain between B and the centre of permanent position charge or if Y contains a terminal carbon atom bonded to B, a valence bond;

X is a zwitterionic group selected from groups IVB, IVC, IVD, IVE and IVF in which group IVB has the formula



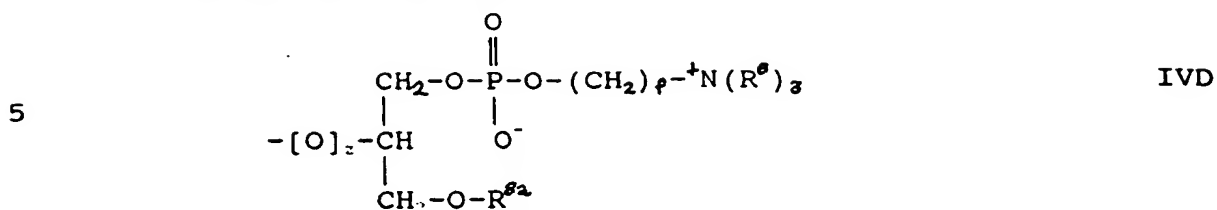
wherein the groups  $R^6$  are the same or different and each is hydrogen or  $C_{1-4}$  alkyl and d is from 2 to 4;

group IVC has the formula



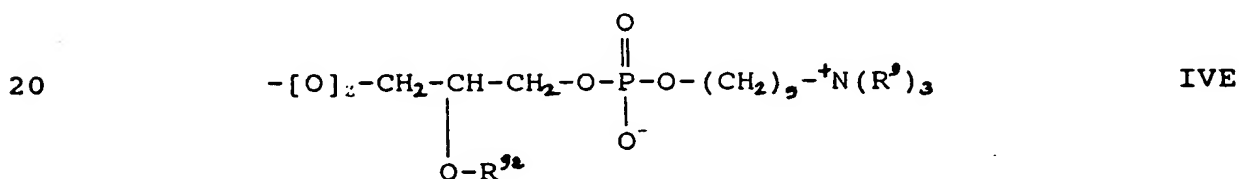
where the groups  $R^7$  are the same or different and each is hydrogen or  $C_{1-4}$  alkyl, and e is from 1 to 4;

group IVD has the formula



wherein the groups  $R^g$  are the same or different and each is hydrogen or  $C_{1-4}$  alkyl,  $R^{ga}$  is hydrogen or a group  $\text{-C(O)B}^1R^{gb}$  wherein  $R^{gb}$  is hydrogen or methyl,  $B^1$  is a valence bond or straight or branched alkylene, oxaalkylene or oligo-oxaalkylene group, and  $f$  is from 1 to 4; and if  $B$  is other than a valence bond  $z$  is 1 and if  $B$  is a valence bond  $z$  is 0, if  $X$  is directly bonded to an oxygen or nitrogen atom and otherwise  $z$  is 1;

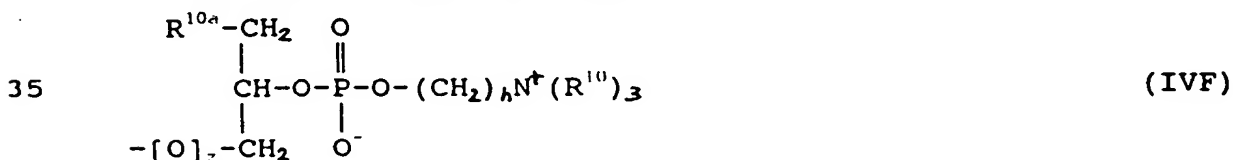
group IVE has the formula



wherein the groups  $R^g$  are the same or different and each is hydrogen or  $C_{1-4}$  alkyl,  $R^{ga}$  is hydrogen or a group  $\text{-C(O)B}^2R^{gb}$ , wherein  $R^{gb}$  is hydrogen or methyl,  $B^2$  is a valence bond or a straight or branched alkylene, oxaalkylene or oligo-oxaalkylene group, and  $g$  is from 1 to 4; and

if  $B$  is other than a valence bond  $z$  is 1 and if  $B$  is a valence bond  $z$  is 0 if  $X$  is directly bonded to an oxygen or nitrogen atom and otherwise  $z$  is 1; and

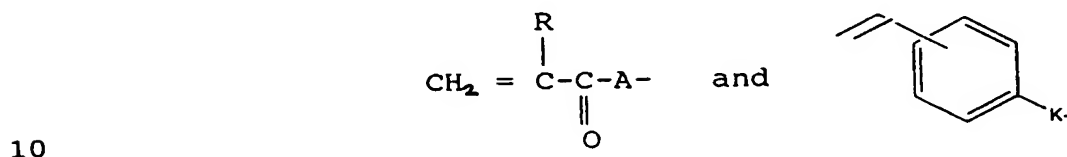
group IVF has the formula



wherein the groups  $R^{10}$  are the same or different and each is hydrogen or  $C_{1-4}$  alkyl,  $R^{10a}$  is hydrogen or a group  $\text{-C(O)B}^3R^{10b}$  wherein  $R^{10b}$  is hydrogen or methyl,  $B^3$  is a valence bond or a straight or branched alkylene, oxaalkylene or oligo-oxaalkylene group, and  $h$  is from 1 to 4; and

if B is other than a valence bond z is 1 and if B is a valence bond z is 0 if X is directly bonded to the oxygen or nitrogen and otherwise z is 1; and

Y is an ethylenically unsaturated polymerisable group  
5 selected from



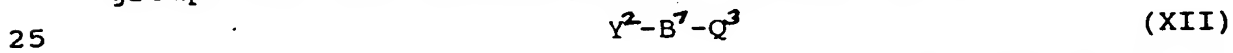
wherein:

R is hydrogen or a C<sub>1</sub>-C<sub>4</sub> alkyl group;

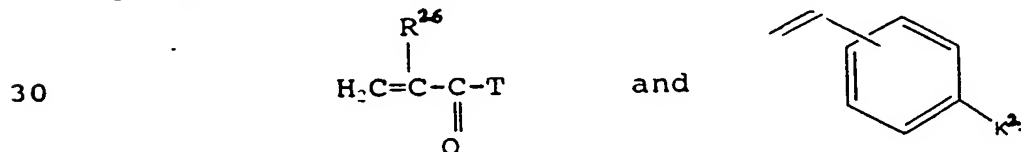
A is -O- or -NR<sup>1</sup>- where R<sup>1</sup> is hydrogen or a C<sub>1</sub>-C<sub>4</sub> alkyl  
15 group or R<sup>1</sup> is -B-X where B and X are as defined above; and

K is a group -(CH<sub>2</sub>)<sub>p</sub>OC(O)-, -(CH<sub>2</sub>)<sub>p</sub>C(O)O-, -(CH<sub>2</sub>)<sub>p</sub>OC(O)O-, -(CH<sub>2</sub>)<sub>p</sub>NR<sup>2</sup>-, -(CH<sub>2</sub>)<sub>p</sub>NR<sup>2</sup>C(O)-, -CH<sub>2</sub>)<sub>p</sub>C(O)NR<sup>2</sup>-, -(CH<sub>2</sub>)<sub>p</sub>NR<sup>2</sup>C(O)O-, -(CH<sub>2</sub>)<sub>p</sub>OC(O)NR<sup>2</sup>-, -(CH<sub>2</sub>)<sub>p</sub>NR<sup>2</sup>C(O)NR<sup>2</sup>-, (in  
20 which the groups R<sup>2</sup> are the same or different) -(CH<sub>2</sub>)<sub>p</sub>O-, -(CH<sub>2</sub>)<sub>p</sub>SO<sub>3</sub>-, or, optionally in combination with B, a valence bond and p is from 1 to 12 and R<sup>2</sup> is hydrogen or a C<sub>1</sub>-C<sub>4</sub> alkyl group, and

said radical polymerisable monomer containing reactive groups has the formula general formula (XII)



where Y<sup>2</sup> is an ethylenically unsaturated polymerisable group selected from



where R<sup>26</sup> is hydrogen or C<sub>1</sub>-C<sub>4</sub> alkyl;

35 T is -O- or NR<sup>27</sup>-, wherein R<sup>27</sup> is hydrogen or a C<sub>1</sub>-C<sub>4</sub> alkyl group or R<sup>27</sup> is a group -B<sup>7</sup>Q<sup>3</sup>;

B<sup>7</sup> is a valence bond a straight or branched alkylene oxaalkylene or oligo-oxaalkylene group;

40 K<sup>2</sup> is a group -(CH<sub>2</sub>)<sub>q</sub>OC(O)-, -(CH<sub>2</sub>)<sub>q</sub>C(O)O-, -(CH<sub>2</sub>)<sub>q</sub>OC(O)O-, -(CH<sub>2</sub>)<sub>q</sub>NR<sup>20</sup>-, -(CH<sub>2</sub>)<sub>q</sub>NR<sup>20</sup>C(O)-,

$-(CH_2)_qC(O)NR^{20}-$ ,  $-(CH_2)_qNR^{20}C(O)O-$ ,  $-(CH_2)_qOC(O)NR^{20}-$ ,  
 $-(CH_2)_qNR^{20}C(O)NR^{20}-$  (in which the groups  $R^{20}$  are the same or  
 different),  $-(CH_2)_qO-$ , or  $-(CH_2)_qSO_3-$ , or a valence bond and  
 q is from 1 to 12 and  $R^{20}$  is hydrogen or a  $C_1-C_4$  alkyl  
 5 group; and

$Q^3$  is a reactive group selected from the group  
 consisting of aldehyde groups; silane and siloxane groups  
 containing one or more substituents selected from halogen  
 atoms and  $C_{1-4}$ -alkoxy groups; hydroxyl; amino; carboxyl;  
 10 epoxy;  $-CHOHCH_2Hal$  (in which Hal is selected from chlorine,  
 bromine and iodine atoms); succinimido; tosylate; triflate;  
 imidazole carbonyl amino; optionally substituted triazine  
 groups; acetoxy; mesylate; carbonyl di(cyclo)alkyl  
 carbodiimidoyl; and oximino.

15 2. A process according to claim 1 in which  $Q^3$  is selected  
 from the group consisting of aldehyde, reactive silane and  
 siloxane amino, epoxy,  $CHOHCH_2Hal$  (in which Hal is  
 halogen), succinimido, tosylate, triflate,  
 imidazolecarbonyl amino and optionally substituted triazine  
 20 groups.

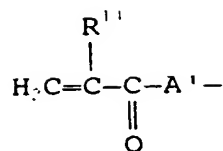
3. A process according to claim 1 in which the surface  
 pendant groups are selected from the group consisting of  
 hydroxyl, carboxyl and amine groups.

4. A process according to claim 1 in which the polymer is  
 25 formed from 2-(methacryloyloxyethyl)-2'-(trimethylammonium)  
 ethyl phosphate inner salt and 2-aminoethylmethacrylate and  
 in which the covalent bonding of the pendant amino group is  
 to a surface having pendant carboxylate groups is achieved  
 through the formation of an amide linkage.

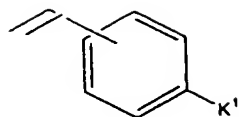
30 5. A process according to claim 1 in which the said  
 radical polymerisable monomers include a comonomer of the  
 general formula VI



where  $Y'$  is an ethylenically unsaturated polymerisable  
 35 group selected from



and



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where  $\text{R}^{14}$  is selected from the group consisting of hydrogen and  $\text{C}_1\text{-C}_4$  alkyl,

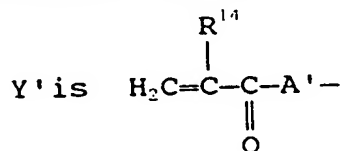
10  $\text{A}'$  is  $-\text{O}-$  or  $-\text{NR}^{15}-$  where  $\text{R}^{15}$  is selected from the group consisting of hydrogen,  $\text{C}_1\text{-C}_4$  alkyl groups and groups  $\text{Q}$ ;

$\text{K}^1$  is selected from the group consisting of  $-(\text{CH}_2)_1\text{OC}(\text{O})-$ ,  $-(\text{CH})_1\text{C}(\text{O})\text{O}-$ ,  $-(\text{CH}_2)_1\text{OC}(\text{O})\text{O}-$ ,  $-(\text{CH}_2)_1\text{NR}^{16}-$ ,  $-(\text{CH}_2)_1\text{NR}^{16}\text{C}(\text{O})-$ ,  $-(\text{CH}_2)_1\text{C}(\text{O})\text{NR}^{16}-$ ,  $-(\text{CH}_2)_1\text{NR}^{16}\text{C}(\text{O})-$ ,  $-(\text{CH}_2)_1\text{OC}(\text{O})\text{NR}^{16}-$ ,  $-(\text{CH}_2)_1\text{NR}^{16}\text{C}(\text{O})\text{NR}^{16}-$  in which the groups  $\text{R}^{16}$  are the same or different),  $-(\text{CH}_2)_1\text{O}-$ ,  $-(\text{CH}_2)_1\text{SO}_3-$  and a bond, in which 1 is from 1 to 12 and  $\text{R}^{16}$  is selected from the group consisting of hydrogen and  $\text{C}_1\text{-C}_4$  alkyl groups; and

15  $\text{Q}$  is selected from the group consisting of straight and branched alkyl, alkoxyalkyl and (oligo-alkoxy)alkyl groups containing 6 to 24 carbon atoms, any of which groups is unsubstituted or substituted by one or more fluorine atoms and optionally contains one or more carbon-carbon double or triple bonds; and

20 siloxane groups  $-(\text{CR}^{16a})_{qq}(\text{SiR}^{16b})_p(\text{OSiR}^{16b})_{pp}\text{R}^{16b}$  in which each group  $\text{R}^{16a}$  is the same or different and is selected from the group consisting of hydrogen, alkyl groups of 1 to 4 carbon atoms and aralkyl groups, each group  $\text{R}^{16b}$  is alkyl of 1 to 4 carbon atoms,  $qq$  is from 1 to 6 and  $pp$  is from 0 to 49.

30 6. A process according to claim 5 in which



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in which  $\text{R}^{14}$  is methyl and  $\text{A}'$  is  $-\text{O}-$  and  $\text{Q}$  is an alkyl group of the formula  $-(\text{CR}^{17})_m\text{CR}^{17}$ , wherein the groups  $-(\text{CR}^{17})_m-$  are the same or different and in each group  $-(\text{CR}^{17})_m-$  the groups  $\text{R}^{17}$  are the same or different and each group  $\text{R}^{17}$  is selected

from the group consisting of hydrogen, C<sub>1-4</sub>-alkyl and -fluoroalkyl and fluorine and m is in the range 5 to 23.

7. A process according to claim 6 in which the said comonomer is selected from the group consisting of n-  
5 dodecyl methacrylate, octadecyl methacrylate, hexadecyl methacrylate, 1H,1H,2H,2H-heptadecafluorodecyl methacrylate, p-octyl styrene, p-dodecyl styrene and monomethacryloxypropyl terminated siloxanes.

8. A process according to claim 7 in which the said  
10 comonomer is dodecyl methacrylate.

9. A process according to claim 1 in which the said radical polymerisable monomers include a diluent monomer selected from the group consisting of C<sub>1-4</sub>-alkyl(alk)acrylates, N,N-dialkylamino alkyl(alk)acrylates  
15 containing 1 to 4 carbon atoms in each N-alkyl group and 1 to 4 carbon atoms in the alkylene group, C<sub>1-4</sub>-alkyl(alk)acrylamide, hydroxy C<sub>1-4</sub>-alkyl(alk)acrylate, N-vinyl lactam having 5-7 atoms in the lactam ring, styrene, derivatives of styrene having ring substituents  
20 selected from C<sub>1-4</sub>-alkyl groups and halogen atoms, polyhydroxyl (alk)acrylates, alkenes, butadiene, maleic anhydride and acrylonitrile.

10. A process according to claim 9 in which the diluent monomer is selected from hydroxy C<sub>1-4</sub>-alkyl(alk)acrylates  
25 and polyhydroxyl(alk)acrylates.

11. A process according to claim 1 in which the said radical polymerisable monomers include at least 5% by weight zwitterionic monomer and at least 0.1% by weight monomer having a reactive group.

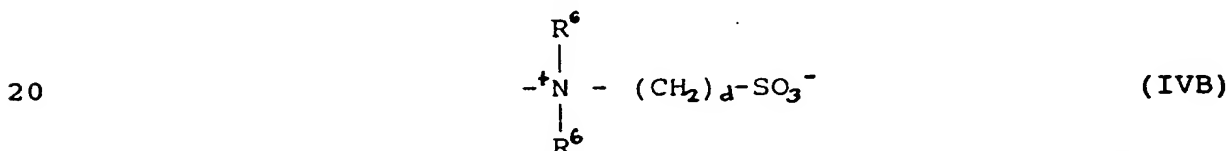
30 12. A process according to claim 9 in which the said radical polymerisable monomers include at least 5% by weight zwitterionic monomer, at least 0.1% by weight monomer having a reactive group and 5 to 20% by weight diluent monomer.

35 13. A process according to claim 5 in which the said radical polymerisable monomers include at least 5% by weight zwitterionic monomer, at least 0.1% by weight

monomer having a reactive group and 5 to 90% by weight of said comonomer.

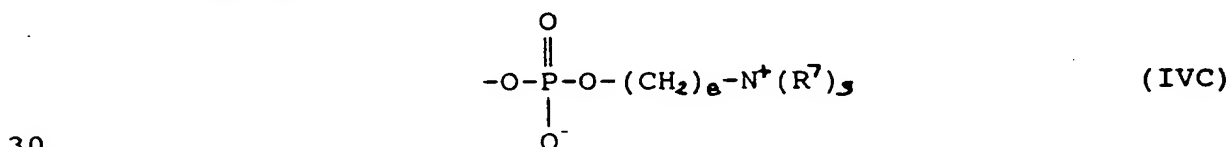
14. A biocompatibilising process in which a substrate having a surface which bears substrate pendant functional groups is biocompatibilised by coating it with a coating composition containing a polymer formed from a radical polymerisable monomers including a radical polymerisable zwitterionic monomer and a radical polymerisable monomer containing a reactive group to form a polymer having zwitterionic groups and pendant reactive groups and the said pendant reactive groups are reacted to form covalent bonds with said substrate pendant functional group and thereby form a stable coating of polymer on the said surface.

15. A process according to claim 14 in which the zwitterionic group is a group X selected from groups IVB, IVC, IVD, IVE and IVF in which group IVB has the formula



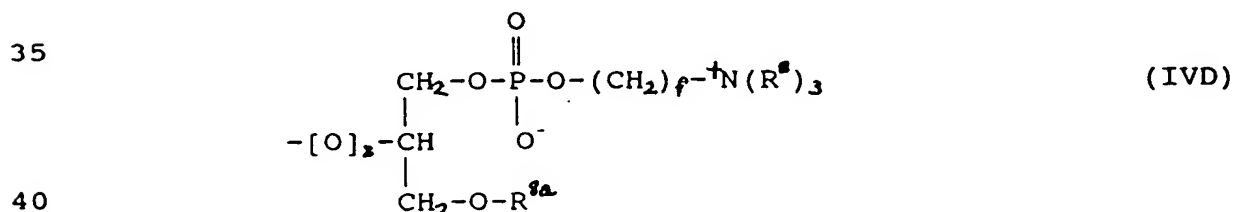
wherein the groups R<sup>6</sup> are the same or different and each is hydrogen or C<sub>1-4</sub> alkyl and d is from 2 to 4;

group IVC has the formula



where the groups R<sup>7</sup> are the same or different and each is hydrogen or C<sub>1-4</sub> alkyl, and e is from 1 to 4;

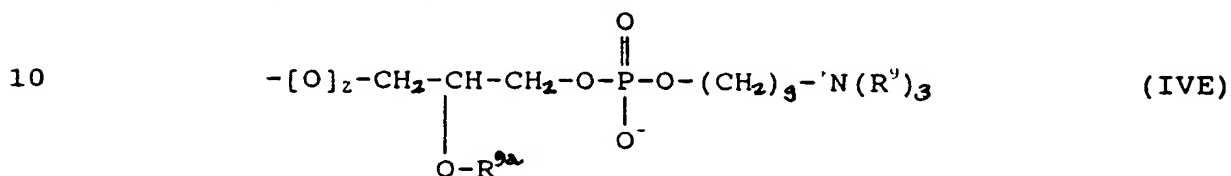
group IVD has the formula



wherein the groups R<sup>8</sup> are the same or different and each is hydrogen or C<sub>1-4</sub> alkyl, R<sup>8a</sup> is hydrogen or a group -C(O)B<sup>1</sup>R<sup>8b</sup>

wherein  $R^{2a}$  is hydrogen or methyl,  $B^1$  is a valence bond or straight or branched alkylene, oxaalkylene or oligo-oxaalkylene group, and  $f$  is from 1 to 4; and if  $B$  is other than a valence bond  $z$  is 1 and if  $B$  is a valence bond  $z$  is 0, if  $X$  is directly bonded to an oxygen or nitrogen atom and otherwise  $z$  is 1;

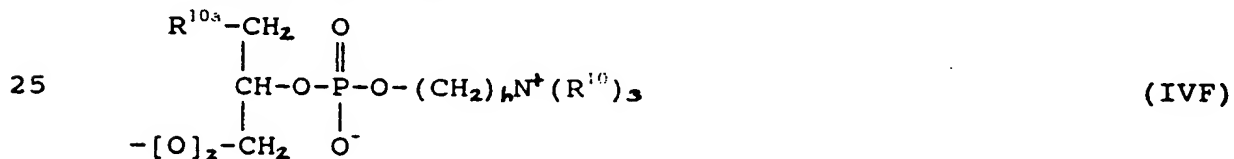
group IVE has the formula



wherein the groups  $R^9$  are the same or different and each is hydrogen or  $C_1-C_4$  alkyl,  $R^{2a}$  is hydrogen or a group  $-C(O)B^2R^{2b}$ , wherein  $R^{2b}$  is hydrogen or methyl,  $B^2$  is a valence bond or a straight or branched alkylene, oxaalkylene or oligo-oxaalkylene group, and  $g$  is from 1 to 4; and

if  $B$  is other than a valence bond  $z$  is 1 and if  $B$  is a valence bond  $z$  is 0 if  $X$  is directly bonded to an oxygen or nitrogen atom and otherwise  $z$  is 1; and

group IVF has the formula



wherein the groups  $R^{10}$  are the same or different and each is hydrogen or  $C_1-C_4$  alkyl,  $R^{10a}$  is hydrogen or a group  $-C(O)B^3R^{10b}$  wherein  $R^{10b}$  is hydrogen or methyl,  $B^3$  is a valence bond or a straight or branched alkylene, oxaalkylene or oligo-oxaalkylene group, and  $h$  is from 1 to 4; and

if  $B$  is other than a valence bond  $z$  is 1 and if  $B$  is a valence bond  $z$  is 0 if  $X$  is directly bonded to the oxygen or nitrogen and otherwise  $z$  is 1.

16. A process according to claim 14 in which the pendant functional group on the polymer is a group  $Q^3$  selected from the group consisting of aldehyde groups; silane and siloxane groups containing one or more substituents selected from halogen atoms and  $C_1-C_4$ -alkoxy groups;



hydroxyl; amino; carboxyl; epoxy;  $-\text{CHOHCH}_2\text{Hal}$  (in which Hal is selected from chlorine, bromine and iodine atoms); succinimido; tosylate; triflate; imidazole carbonyl amino; optionally substituted triazine groups; aceoxy; mesylate; carbonyl di(cyclo)alkyl carbodiimidoyl; and oximino.

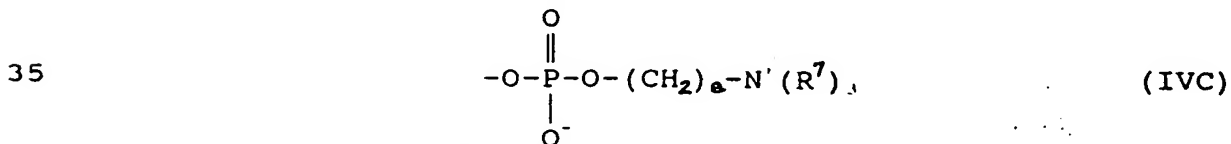
17. A process according to claim 15 in which the pendant functional group on the polymer is a group  $\text{Q}^3$  selected from the group consisting of aldehyde groups; silane and siloxane groups containing one or more substituents selected from halogen atoms and  $\text{C}_{1-4}$ -alkoxy groups; hydroxyl; amino; carboxyl; epoxy;  $-\text{CHOHCH}_2\text{Hal}$  (in which Hal is selected from chlorine, bromine and iodine atoms); succinimido; tosylate; triflate; imidazole carbonyl amino; optionally substituted triazine groups; aceoxy; mesylate; carbonyl di(cyclo)alkyl carbodiimidoyl; and oximino.

18. A process according to claim 16 in which the pendant functional group is selected from the group consisting of aldehyde, reactive silane and siloxane amino, epoxy,  $\text{CHOHCH}_2\text{Hal}$  (in which Hal is halogen), succinimido, tosylate, triflate, imidazolecarbonyl amino and optionally substituted triazine groups.

19. A process according to claim 17 in which the pendant functional group is selected from the group consisting of aldehyde, reactive silane and siloxane amino, epoxy,  $\text{CHOHCH}_2\text{Hal}$  (in which Hal is halogen), succinimido, tosylate, triflate, imidazolecarbonyl amino and optionally substituted triazine groups.

20. A process according to claim 14 in which the surface pendant groups are selected from the group consisting of hydroxyl, carboxyl and amine groups.

21. A process according to claim 14 in which the zwitterionic group is a group of formula IVC



where the groups  $\text{R}^7$  are the same or different and each is hydrogen or  $\text{C}_{1-4}$  alkyl, and  $e$  is from 1 to 4;

the pendant functional group of the polymer is an amine group and

the pendant functional group on the substrate surface is a carboxyl group and in which the said covalent bond  
5 which is formed is an amide bond.